

May 29, 1945.

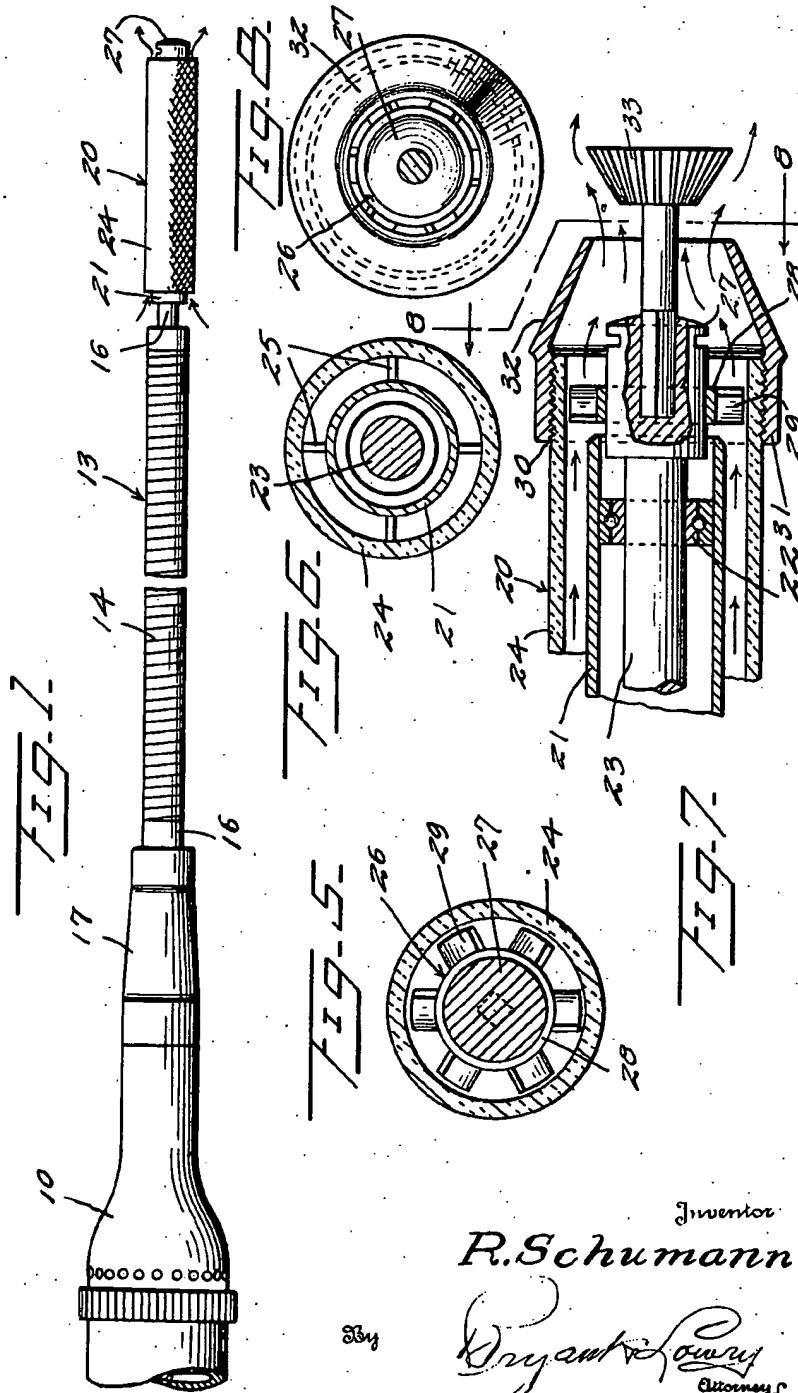
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2,377,271

FLEXIBLE SHAFT AND AIR-COOLED HAND-PIECE

Filed Dec. 12, 1942

2 Sheets-Sheet 1



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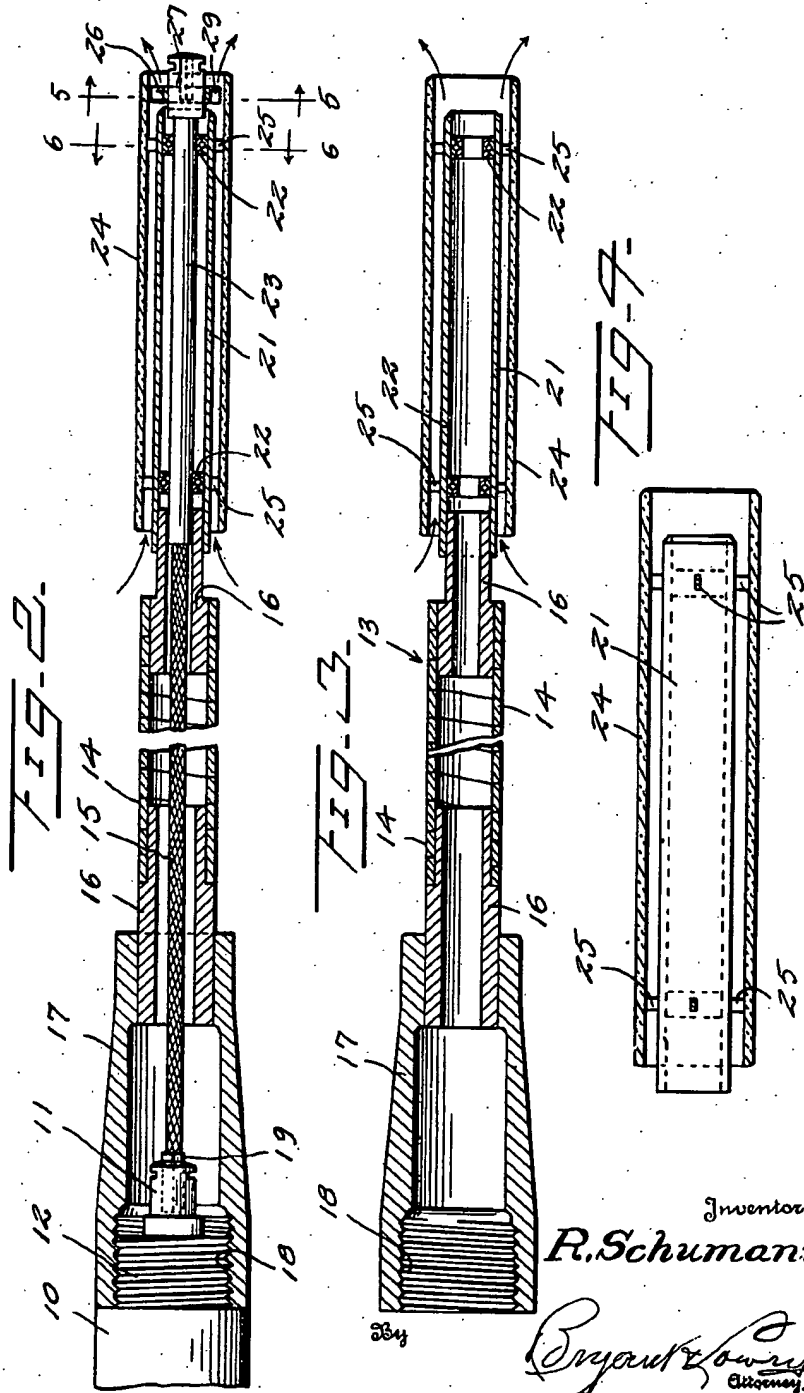
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2 Sheets-Sheet 2



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## UNITED STATES PATENT OFFICE

2,377,271

FLEXIBLE SHAFT AND AIR-COOLED  
HAND PIECERobert Schumann, Racine, Wis., assignor to Anne  
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Application December 12, 1942, Serial No. 468,857

8 Claims. (Cl. 64—2)

This invention relates generally to machines for grinding, sanding, buffing, drilling, etc., and pertains more particularly to an improved flexible shaft and hand piece therefor.

At the present time flexible shafts are used as a unit in fixed attachment to stationary motors. These flexible shafts, which are used for rotating various types of implements such as grinders, drills, buffers, sanders and the like, have hand pieces which, due to the high speed at which the flexible shaft core rotates, become very hot, thus necessitating frequent interruption of the work being done to permit the hand piece to cool. Some hand pieces are provided with insulation covering but such covering does not fully protect the operator's hands against the heat developed.

Hand tools, driven by air or electricity, are also employed for performing the different types of operations previously stated but such tools are not designed for the attachment thereto of flexible shafts having hand pieces and no means has been heretofore devised for attaching such flexible shafts to hand tools.

A principal object of the present invention, in view of the foregoing, is to provide an improved flexible shaft having a hand piece of novel construction which is air-cooled and which may, therefore, be continuously used while the tool is operated at high speed, without becoming heated.

Another object of the invention is to provide a flexible shaft with a hand piece, in which the hand piece is provided with air passages by means of which heat developed in the bearings for supporting the core in the hand piece, may be carried off without being transferred to the outer part of the hand piece which is held in the hand.

Still another object of the invention is to provide a flexible shaft with a hand piece, having an adapter by means of which the sheath of the shaft may be coupled with a hand tool and the power transmitting core may be secured in the rotatable chuck of the tool.

A still further object of the invention is to provide a flexible shaft with a hand piece, in which means is provided in the form of fan blades, operatively coupled with the rotatable core of the shaft, for maintaining a forced circulation of air through the hand piece and across the implement which is connected with and rotated by the core.

The invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawings forming a part of the specification, with

the understanding that the invention is not confined to any strict conformity therewith but may be changed or modified within the scope of the appended claims.

In the drawings:

Figure 1 is a view in side elevation of a flexible shaft and hand piece constructed in accordance with the present invention, the same being shown applied to a hand tool of the electric or air driven type,

Figure 2 is a longitudinal section through the structure as illustrated in Figure 1,

Figure 3 is a longitudinal section corresponding to Figure 2 showing the invention without the rotatable core and detached from the power tool,

Figure 4 is a view partly in longitudinal section and partly in elevation of the hand piece per se,

Figure 5 is a sectional view taken on line 5—5 of Figure 2,

Figure 6 is a sectional view taken on line 6—6 of Figure 2;

Figure 7 is a view in longitudinal section of the forward end of the hand piece showing thereon a grinding implement and, in section, a nozzle for directing the air in a concentrated stream around the implement; and

Figure 8 is a transverse section taken on line 8—8 of Figure 7.

Referring now more particularly to the drawings, the numeral 10 generally designates the forward end of a hand tool such as is commonly employed for the performance of grinding, drilling and other operations through the attachment thereto, by means of the chuck 11, of the desired implement. These hand tools are driven by electricity or compressed air and operate at high speed which may be from 20,000 to 40,000 R. P. M.

The forward end of the tool is screw threaded as indicated at 12 and carries a threaded cap or collar, not shown, which is secured by the threads 12. In the application of the flexible shaft of the present invention this cap or collar is removed and the threads 12 are employed for securing the shaft to the tool.

In accordance with the present invention there is provided the flexible shaft which is indicated generally by the numeral 13 and which comprises the usual outer spiral sheath 14 and the flexible core 15 which extends through the sheath. In each end of the sheath there is secured a sleeve 16.

One of the sleeves 16 functions to couple with one end of the sheath an adapter 17 which is in the form of an elongated, slightly tapered, tubu-

lar body into one end of which the sleeve 16 is secured while the other end is interiorly threaded as indicated at 18 to receive and establish a threaded connection with the threads 12 of the tool. The interior of the adapter is sufficiently large to receive the tool chuck 11.

As shown, the flexible shaft core 15 is of a length to extend through the major portion of the adapter and it is squared or otherwise suitably shaped as indicated at 19 to effect its secure connection in the chuck.

The sleeve 16 at the forward or free end of the shaft functions to establish the desired connection between the sheath 14 and the hand piece which is designated generally 20.

The hand piece 20 comprises a central, relatively long tubular portion 21 in which are housed bearing units 22 which are disposed preferably one adjacent each end of the hand piece. These bearing units rotatably support a shaft 23 which is secured at one end to the flexible core 15 and forms a continuation or integral part of the core. While the core has been previously referred to as being designated by the numeral 15 it will be understood that the use of the term "core" hereinafter and in the claims will be understood to mean the entire rotary connection between the chuck 11 and the working implement, thus including in this term the two parts 15 and 23.

Encircling and in spaced relation with the inner tubular portion 21 of the hand piece is an outer tubular portion 24 which forms the hand grip for the hand piece and which is preferably constructed from heat insulating material. The hand grip portion 24 is materially larger in interior diameter than the overall diameter of the inner portion 21 and is maintained spaced from and concentric with the inner portion by the radial arms 25. As shown in Figures 2 to 4 the hand grip portion also extends slightly beyond the forward end of the inner portion 21, thus providing space within the hand grip at its forward end for a fan 26 which is mounted upon the hand piece chuck 27 which in turn is secured to and supported by the forward end of the core shaft 23.

The fan 26 may be of any suitable construction but is here shown as comprising a hub portion 28 which is fitted about the hand piece chuck 27 and the blades 29 extending outwardly from the hub to close proximity to the wall of the hand grip.

It will be readily apparent from the foregoing that the hand piece may be used with or without the fan. Without the fan a circulation of air will be had through the hand grip to carry off heat radiated from the bearings 22 and the inner portion 21. However, by the employment of the fan a forced circulation of air through the hand piece will be maintained while the core is rotating and thus the generated heat will be more rapidly removed.

Figure 7 illustrates a slight modification of the hand piece structure wherein the forward end of the hand grip 24 is modified by the formation of screw threads around the same as indicated at 30 to receive the collar portion 31 of a conical nozzle 32 which projects beyond the forward end of the hand grip and functions to concentrate the air stream issuing from the forward end of the hand grip. The air stream is thus forced to circulate around the cutting tool or implement 33 which is secured in the hand piece chuck and functions to clean the tool and also keep down the temperature of the same as well as striking the

work being machined to remove chips or other particles therefrom.

From the foregoing it will be readily apparent that the present invention provides first a flexible power transmitting shaft with hand piece, which is readily adaptable to electric and air driven hand tools or power units, whereby such hand tools may be conveniently used in locations where the much heavier outfits of stationary units could not be used, and, second, provides a hand piece which will keep cool and at an easily handled temperature at all times regardless of the speed at which the tool is operated thereby making it unnecessary for the operator of the tool to periodically interrupt his work so as to allow the hand piece to cool off or to wear gloves for the protection of his hand.

While the invention has been illustrated and described in association with a hand tool, it will be readily apparent that it can be used in connection with stationary units where the driving motor is fixed to and carried upon a supporting stand or pedestal.

I claim:

1. A flexible shaft and hand piece unit adaptable to a power machine having a tool chuck, comprising a flexible sheath, a flexible core extending through and adapted to turn in the sheath, an internally threaded tubular adapter coupling the sheath at one end with said machine, means in the adapter for coupling the said one end of the flexible core in the machine chuck, a hand piece connected with the other end of the shaft and having the other end of the flexible core extending therethrough and supported for turning therein, a tool chuck carried on the said other end of the flexible core, said hand-piece including concentric spaced cylinders with the flexible core extending through the inner cylinder, the outer cylinder being open at both ends with the inner end terminating in spaced relation to the adjacent end of the flexible sheath, and a fan within the outer end of the outer cylinder for creating a circulation of air between the cylinders in a direction toward the outer ends thereof for cooling the hand-piece.

2. A hand-piece for a rotatably operated work implement comprising an elongated hollow hand-grip having both ends open, a central portion of tubular form extending through the hand-grip in spaced relation thereto, means maintaining the hand-grip and central portion spaced to provide an air passageway through the hand-grip, a shaft extending through and rotatably supported within the central portion, means for securing a working implement to one end of the shaft to be rotated thereby, and a fan within the end of the hand grip nearest the implement securing means for creating a forced circulation of air through the hand grip and around the central portion.

3. A hand-piece for a rotatably operated work implement comprising an elongated hollow hand-grip having both ends open, a central portion of tubular form extending through the hand-grip in spaced relation thereto, means maintaining the hand-grip and central portion spaced to provide an air passageway through the hand-grip, a shaft extending through and rotatably supported within the central portion, means for securing a working implement to one end of the shaft to be rotated thereby, and means within the end of the hand grip nearest the implement securing means and secured to the shaft to be operated thereby for creating a forced circulation of air

through the hand grip and around the central portion.

4. A hand-piece for a rotatably operated work implement comprising an elongated hollow hand-grip having both ends open, a central portion of tubular form extending through the hand-grip in spaced relation thereto, means maintaining the hand-grip and central portion spaced to provide an air passageway through the hand-grip, a shaft extending through and rotatably supported within the central portion, means for securing a working implement to one end of the shaft to be rotated thereby, and a fan housed in the end of the hand grip nearest the implement securing means and secured to said shaft to be rotated thereby for creating a forced circulation of air through the hand grip and around the central portion.

5. A hand-piece for a rotatably operated work implement comprising an elongated hollow hand-grip having both ends open, a central portion of tubular form extending through the hand-grip in spaced relation thereto, means maintaining the hand-grip and central portion spaced to provide an air passageway through the hand-grip, a shaft extending through and rotatably supported within the central portion, means for securing a working implement to one end of the shaft to be rotated thereby, a fan housed in the end of the hand grip nearest the implement securing means and secured to said shaft to be rotated thereby for creating a forced circulation of air through the hand grip and around the central portion, and a nozzle attached to the said end of the hand grip for condensing the stream of air generated by the fan and issuing from the hand grip.

6. A flexible shaft and hand piece, comprising a flexible tubular sheath, an adapter upon one end of the sheath for connection with a power tool

over a chuck, an elongated hand piece having a tubular central portion secured at one end to the other end of the sheath and a tubular hand grip portion encircling the central portion in spaced relation therewith and open at its ends, a core extending through and adapted to turn in the adapter sheath and central portion of the hand grip, the core at the adapter end being designed for securing in the tool chuck, a chuck carried upon the other end of the core, and means connected with and operated by the core within the hand piece for creating a forced circulation of air through the hand grip portion and around the central portion.

7. A flexible shaft and hand piece, comprising a flexible tubular sheath, an adapter upon one end of the sheath for connection with a power tool over a chuck, an elongated hand piece having a tubular central portion secured at one end to the other end of the sheath and a tubular hand grip portion encircling the central portion in spaced relation therewith and open at its ends, a core extending through and adapted to turn in the adapter, sheath and central portion of the hand grip, the core at the adapter end being designed for securing in the tool chuck, the said central portion at the end remote from the sheath terminating short of the adjacent end of the hand grip, a chuck carried upon the other end of the core, and a fan coupled with the said other end of the core and housed within the hand grip portion forwardly of the short end of the central portion, to be turned by the core to create a circulation of air through the hand grip.

8. A flexible shaft and hand piece as set forth in claim 6, with a nozzle carried upon the end of the hand grip adjacent to the second mentioned chuck for condensing the air stream issuing from the hand grip portion.

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